CLAIMS

What is claimed is:

1. A method of regenerating a used sorbent comprising:
creating a sorbent mixture containing used sorbent and unused sorbent;
exposing the sorbent mixture to a solution to remove contaminants collected on the used sorbent to restore mercury sorption effectiveness to the sorbent;
dewatering the sorbent mixture to remove sorbent particles from the solution; and
drying the dewatered sorbent mixture.

2. The method of claim 1, wherein ash is separated from the used sorbent prior to exposure of the sorbent mixture to the solution.

3. The method of claim 1, wherein the solution includes an inorganic acid solution.

4. The method of claim 3, the inorganic acid solution includes at least one of hydrochloric acid (HCl), hydrobromic acid (HBr), and hydroiodic acid (HI).

5. The method of claim 1, wherein the solution is a salt solution.

6. The method of claim 5, the salt solution includes a halide salt, containing an associated cation, such as ammonium, sodium, potassium, iron, aluminum, boron, zinc, manganese, magnesium, calcium.

7. The method of claim 1, wherein the solution includes an organic acid.

8. The method of claim 7, the organic acid solution includes at least one of citric acid, tartaric acid, oxalic acid, malonic acid, maleic acid, formic acid, and acetic acid.

9. The method of claim 1, wherein the solution includes an organic salt solution.

10. The method of claim 9, wherein the organic salt solution includes:
at least one anion from at least one of citric acid, tartaric acid, oxalic acid, malonic acid, maleic acid, formic acid, and acetic acid; and
at least one associated cation, such as ammonium, sodium, potassium, iron, aluminum, boron, zinc, manganese, magnesium, or calcium.

11. The method of claim 1, wherein the solution contains only water.

12. The method of claim 1, wherein the used sorbent contains constituents derived from a flue gas stream.

13. The method of claim 1, wherein the sorbent is activated carbon.

14. The method of claim 1, wherein the contaminant includes sulfuric acid.

15. The method of claim 1, wherein the mercury sorption effictiveness of the sorbent is restored by removing anions collected on the used sorbent.

16. The method of claim 1, wherein the mercury sorption effectiveness of the sorbent is restored by removing sulfuric acid from the sorbent.

17. The method of claim 1, further comprising agitating the sorbent mixture and the solution.

18. The method of claim 1, further comprising mixing an additive with the regenerated sorbent prior to injecting the regenerated sorbent into the flue gas stream.

19. The method of claim 18, wherein the additive neutralizes acids.

20. The method of claim 18, wherein the additive is a calcium-based additive.

21. A method of regenerating a used sorbent comprising:
exposing the used sorbent to a solution to remove contaminants collected on the used sorbent to restore mercury sorption effectiveness to the sorbent;
dewatering the sorbent to remove sorbent particles from the solution; and
drying the dewatered sorbent mixture.

22. The method of claim 21, wherein the solution includes an inorganic acid solution.

23. The method of claim 21, wherein the solution is a salt solution.

24. The method of claim 21, wherein the solution includes an organic acid.

25. The method of claim 21, wherein the solution includes an organic salt solution.

26. The method of claim 21, wherein the sorbent is activated carbon.

27. A method of regenerating a used sorbent comprising:

creating a sorbent mixture containing used sorbent and unused sorbent;
regenerating the used sorbent by exposing the sorbent mixture to a solution to remove contaminants collected on the used sorbent to restore mercury sorption effectiveness to the sorbent; and
exposing the regenerated sorbent to a flue gas stream.

28. The method of claim 27, wherein the regenerated sorbent is exposed to the flue gas stream by injecting the regenerated sorbent into the flue gas stream.

29. The method of claim 27, wherein the regenerated sorbent is exposed to the flue gas stream using a fixed sorbent bed.

30. The method of claim 27, wherein the regenerated sorbent is exposed to the flue gas stream using a traveling sorbent bed.

31. The method of claim 27, wherein the regenerated sorbent is exposed to the flue gas stream using a traveling fiber filter.

32. The method of claim 27, wherein the solution includes an inorganic acid solution.

33. The method of claim 27, wherein the solution is a salt solution.

34. The method of claim 27, wherein the solution includes an organic acid.

35. The method of claim 27, wherein the solution includes an organic salt solution.

36. The method of claim 27, wherein the sorbent is activated carbon.

37. A method of enhancing the effectiveness of a sorbent comprising:
exposing the sorbent to a solution that increases sorbent effectiveness;
dewatering the sorbent to remove sorbent particles from the solution; and
drying the dewatered sorbent.

38. The method of claim 37, wherein the solution includes an inorganic acid solution.

39. The method of claim 37, wherein the solution is a salt solution.

40. The method of claim 37, wherein the solution includes an organic acid.

41. The method of claim 37, wherein the solution includes an organic salt solution.

42. The method of claim 37, wherein the sorbent is activated carbon.

43. A method of enhancing the effectiveness of a sorbent comprising:
enhancing the sorbent by exposing the sorbent to a solution that increases sorbent effectiveness; and
exposing the enhanced sorbent to a flue gas stream.

44. The method of claim 43, wherein the enhanced sorbent is exposed to the flue gas stream by injecting the enhanced sorbent into the flue gas stream.

45. The method of claim 43, wherein the enhanced sorbent is exposed to the flue gas stream using a fixed sorbent bed.

46. The method of claim 43, wherein the enhanced sorbent is exposed to the flue gas stream using a traveling sorbent bed.

47. The method of claim 43, wherein the enhanced sorbent is exposed to the flue gas stream using a traveling fiber filter.

48. The method of claim 43, wherein the solution includes an inorganic acid solution.

49. The method of claim 43, wherein the solution is a salt solution.

50. The method of claim 43, wherein the solution includes an organic acid.

51. The method of claim 43, wherein the solution includes an organic salt solution.

52. The method of claim 43, wherein the solution includes a compound comprised of a halogen combined with a Group V or Group VI element.

53. The method of claim 52, wherein the compound includes one or more of thionyl chloride, sulfuryl chloride, phosphorus trichloride, phosphorus oxychloride, hypochlorous acid, and chlorine.

54. The method of claim 52, wherein the compound is includes one or more of thionyl bromide, sulfuryl bromide, phosphorus tribromide, phosphorus oxybromide, hypobromous acid, and bromine.

55. The method of claim 43, wherein the sorbent is activated carbon.

56. A method of removing mercury or other pollutants in a flue gas stream during the burning of fossil fuels, comprising:
exposing the sorbent to the flue gas stream to remove contaminants from the flue gas stream;
mixing the used sorbent with fresh sorbent and exposing the mixture to a solution to remove contaminants collected on the used sorbent to restore mercury sorption effectiveness to the sorbent;
dewatering the mixture to remove sorbent particles from the solution;
drying the sorbent particles; and
exposing the dried sorbent particles to the flue gas stream to remove additional contaminants from the flue gas stream.

57. The method of claim 56, wherein the sorbent is activated carbon.

58. The method of claim 56, wherein the solution includes an inorganic acid solution.

59. The method of claim 56, wherein the solution is a salt solution.

60. The method of claim 56, wherein the solution includes an organic acid.

61. The method of claim 56, wherein the solution includes an organic salt solution.

62. An apparatus for regenerating a sorbent comprising:
a contact reactor for receiving and containing a mixture of used sorbent and unused sorbent, wherein the mixture in the contact reactor is exposed to an aqueous acidic solution to restore mercury sorption effectiveness to the sorbent;
a dewatering device for removing sorbent particles from the aqueous acidic solution; and
a dryer for drying the sorbent particles.

63. The apparatus of claim 62, wherein the contact reactor further comprises one or more methods for agitating the mixture.

64. The apparatus of claim 62, wherein the dewatering device is comprised of a hydroclone.

65. The apparatus of claim 62, wherein the dewatering device is comprised of a settling tank or thickener.

66. The apparatus of claim 62, wherein the dewatering device is comprised of a filtration device.

67. The apparatus of claim 62, wherein the dryer is comprised of a heat exchanger.

68. The apparatus of claim 62, wherein the dryer is comprised of a fluidization chamber.

69. The apparatus of claim 62, further comprising a sorbent ash separator for separating the used sorbent from ash prior to being received by the contact reactor.